2001 Field Season Progress Report, J. Clark Salyer NWR

PROJECT TITLE: PRESCRIBED FIRE IN NORTHERN MIXED GRASS PRAIRIE: INFLUENCE ON HABITAT AND POPULATION DYNAMICS OF INDIGENOUS WILDLIFE

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INTRODUCTION

Project Justification

Although prescribed fire has been used widely in the northern Great Plains for nearly 30 years, supportive published data on its effects specific to wildlife of the region are scarce. Most available information for fire effects on wildlife and wildlife-habitat relationships in northern mixed grass prairie is anecdotal, unreliable, or is weakly inferred from different grassland ecosystems especially tallgrass prairie. Consequently, resource personnel can only vaguely predict impacts of prescribed burning on indigenous wildlife and many ecological processes in native prairies that form most or all habitat on NWRs in the northern Great Plains. Depending on timing, frequency, and intensity, prescribed fire may, or may not, enhance the integrity of native mixed grass prairie communities.

Background

Grasslands form the largest and perhaps most threatened ecosystem in North America. Native grasslands are being reduced in quantity due primarily to conversion to cropland. For example, tallgrass prairie has been reduced by 99% across nearly all states where it predominated 100-200 years ago, and northern mixed grass prairie has declined by 72-99% (Samson and Knopf 1994). The quality of remaining prairie tracts is increasingly diminished by fragmentation, overgrazing, expansion of introduced plant species, and fire suppression (Samson and Knopf 1994). Not surprisingly, the potential for species extinctions in grasslands is relatively high, e.g., population levels of grassland birds are declining more precipitously than other groups of North American bird species (Samson and Knopf 1996). NWRs and other reserves have been established, in part, to conserve examples of native grassland ecosystems. Appropriate management of such areas becomes increasingly critical for maintaining native biodiversity as unique prairie resources dwindle elsewhere (Johnson 1997, Madden et al. 1999). Still, the ecological integrity of grasslands on NWRs could be compromised, e.g., due to suppression of natural disturbance regimes, principally fire and grazing. Prescribed fire is increasingly used on many NWRs, however, in an attempt to mimic historic fire events. In addition to its role in nutrient cycling, prescribed burning can reduce unnatural, heavy accumulations of fuels that might lead to catastrophic fires in native prairie (Wright and Bailey 1982).

An average of roughly 10,000 ha of grasslands, mostly native mixed grass prairie, is prescribe-burned annually on NWRs in the Dakotas and eastern Montana. Despite this widespread practice, there are few published data on the influence of fire on wildlife in northern mixed grass prairie. Those available are narrow in scope, both in geography and among wildlife species investigated, and they rarely incorporate replication in their design (see Naugle et al. 2000). Furthermore, migratory bird production is central to the mission of NWRs in the northern Great Plains, yet there are almost no published assessments of fire effects on the reproductive output of these birds. Duck nesting densities were reduced by spring burning on Lostwood NWR in northwestern North Dakota, but nest success was unaffected (Kruse and Bowen 1996). At a FWS research station in central North Dakota, ducks nested more successfully in mixed grass prairie burned in fall than in prairie burned in spring (Higgins 1986). No similar reproductive success data are published, however, for grassland songbirds in prescribe-burned areas, on NWRs or elsewhere in northern mixed grass prairie. Two published studies address long-term effects of prescribed fire on grassland songbirds in northern mixed grass prairie (Johnson 1999, Madden et al. 1999), but only report abundance or occurrence information.

Effects of prescribed fire on other nongame wildlife are even less well documented in northern mixed grass prairie. Small mammal communities appear to be strongly influenced by fire, but this conclusion is based on work in tallgrass prairies, from studies generally lacking replication and control plots (Kaufman et al. 1990). Furthermore, some small mammal species may influence the nest success of grassland songbirds via predation on eggs and neonatal young (Pietz and Granfors 2000), or as alternative prey for larger carnivores. Interactions among prescribed fire (i.e., patterns of post-fire succession), habitat conditions, small mammal abundance, and songbird nest success need to be quantified to support decisions for optimally managing both breeding grassland birds and small mammals.

Project Objectives

In an ongoing study (1998-2003), we examine interactions among prescribed fire, habitat conditions, small mammal abundance, and grassland bird productivity. Specifically, we address the following objectives:

(1) Document effects of prescribed fire (i.e., year since fire) on reproductive success of grassland songbirds and upland-nesting ducks in examples of northern mixed grass prairie characteristic of NWRs.

(2) Document effects of prescribed fire on small mammal community composition and species relative abundance.

(3) Document effects of prescribed fire on vegetation community composition and structure.

(4) Quantify nest site habitat and nest site selection for selected grassland birds. Describe and quantify nest habitat selection among 1, 2, and 3+-year post-fire plots.

(5) For land managers, provide basic models and other predictive tools supported by the findings, and synthesize relevant literature.

(6) Provide information on reproductive success of other nesting bird species (e.g., upland-nesting shorebirds, ground-nesting raptors) as encountered.

METHODS

Study Area

Our goal was to select a study site that was representative of habitat typically managed by the USFWS on refuges within the prairie pothole region of the Northern Mixed-grass Prairie. Secondly, our overall intent was to minimize variability among treatment plots within the study area. To meet these goals, we identified the following prerequisites for study site selection:

1) Study site should be unbroken native sod, consisting of a mix of native and exotic vegetation (i.e., not pristine native prairie), habitat typically found on northern prairie refuges. The integrity of many prairie tracts on refuges has been compromised by encroachment of cool-season exotic plants (e.g., smooth brome, Kentucky bluegrass, and leafy spurge). To a large degree, habitat management efforts on NWRs within the region focus on controlling these species.

2) All plots within the study area should have similar landscape metrics. The selected study area consists of a 1,200 acre contiguous grassland bordered to the east by a large semi-permanent wetland complex, and to the west by private agricultural land (see Map). Thus, all burn plots have similar environmental inputs (e.g., temperature, precipitation). **3)** Recent use of prescribed fire as a habitat management tool. With the exception of extreme drought conditions of the mid-1980's and early 1990's, the study area has been prescribe burned about every 3-5 years beginning in the mid 1960's.

Plot selection and prescribed burn rotation

We selected minimum plot size (100 ac) as the area required to locate a minimum sample of nests to estimate daily survival rates under the Mayfield method. Plot size also represents the scale at which many prescribed burns are applied on NWRs in the Prairie Pothole Region. Plots were randomly assigned initial prescribed burns. Subsequent burns follow the schedule outlined in Table 1, with repeat burns at 3-5 year intervals.

Experimental design and proposed analysis

The study of fire ecology, particularly the study of fire effects on plant communities and animal populations is often compromised by poor study design (i.e., it is often difficult to isolate the causal role of fire in observed changes). The literature is rife with conflicting reports for even the most basic fire effects. Although an observational study under field conditions, our design is strengthened by incorporation of elements more typical of a controlled experimental study.

Our primary effects variable is years since fire. Each plot is classified as **1 yr** post fire, **2 yr** post fire, **3 yr** post fire, etc., (Table 1). Our design incorporates elements of 1) time-series analysis (changes in dependent variable within study plots over time), 2) replicated treatment-control analysis (some burned and some unburned plots within any given year), and before/after analysis (parameters are measured pre- and post-treatment; coupled with #2 above commonly referred to as BACI design). Each design has strengths and limitations, but collectively increase our ability to isolate the causal role of fire in affecting plant communities and animal populations. In 2002-03, we will add replicate sites at Des Lacs and Lostwood NWRs, making inference drawn from these data applicable to a wider geographical area.

Field Methods

<u>Avian occurrence and abundance</u>: We assessed bird species use of burn blocks using 100-m

radius point count surveys. We located point counts using a random systematic design. We placed points about 250 m apart, which provided 4-5 survey points within each burn block. We located points with a GPS and marked each with a 1-m post at plot center and a wire survey flag 100 m to the west. One observer completed 2 visits to each of 40 point counts during late May to early July. All birds seen or heard within a 100-m radius of the point during a 5-minute period were noted, and total number of indicated breeding pairs was assessed based on bird behavior. Brown-headed cowbirds flying over a point were also recorded.

<u>Avian Productivity</u>: We searched each burn block systematically using a 25-m rope with tin cans attached with wire at 1-m intervals, pulled by 2 observers. A single trailing observer was often used to facilitate nest location. Often, observers used shorter (15-m) rope drags in brushy areas or simply a "walk and foot-flush" technique targeting areas where birds exhibited breeding behavior. Some nests were found by observing adults carrying food to nestlings (although these nests add few exposure days for Mayfield estimations). To facilitate relocation, we marked each nest with wire surveying flags 3-5 m north and south. We revisited nests about every 3-4 days. Nests nearing fledging were visited every day to minimize uncertainty regarding nest fate. We used direct observation and evidence left at nests to determine fledging success.

<u>Avian nest sites</u>: We characterized plant community composition at all nests using belt transects (10-m radius around each nest). Following GBIRD protocol (University of Montana), we also measured vegetation structural at nest of the most common breeding species. In addition to nest site plots, we sampled vegetation structure and composition at additional plots randomly located within 30-m of the nest (nest site selection) and at randomly located points within study plots (nest plot selection) for savannah sparrow, clay-colored sparrow, and blue winged teal.

<u>Small mammal communities</u>: We incorporated 2 trapping techniques to assess small mammal communities. First, we placed a 30-m trap grid within each burn plot. Each grid contained 20 Museum Special® snap traps and 10 double spring Victor® rat traps arrayed in a systematic design. Second, within each plot we located a 30-meter drift fence, each with eight 5-gallon pitfall traps. Traps and fences were open for a run of 10 consecutive nights in June and again in July. All specimens were frozen and subsequently sent to either the University of North Dakota or the Nebraska State Museum to be verified and cataloged. We did not trap small mammals in

2001.

Use of Video Cameras to Implicate Nest Predators: In collaboration with Northern Prairie Wildlife Research Center (USGS, Biological Resources Division), we monitored 64 passerine nests using miniature video cameras (29 and 35 nest respectively in 1998-99). Fifteen nests were monitored inside burn blocks, 39 in areas adjacent to burn blocks, and 10 were monitored on another grassland bird study area about 20 miles away. We will exclude camera nests from any productivity analyses.

RESULTS

Data from 2001

We systematically searched each burn from 17 May through 13 July. All plots received about the same search effort. We located and monitored 777 nests of 21 species (Tables 2 and 3). The sample included 372 passerine nests, 392 duck nests, and 13 nests of other species (shorebird, hawk, owl, grouse). Brown-headed cowbirds parasitized 57 passerine nests (13% of savannah sparrow, 8% of clay-colored sparrow, and 45% of bobolink nests). Apparent nest success was about 48-57% for the most common passerines, and 21-53% for the most common ducks.

General 4-year Summary

Avian productivity: We have monitored the fate of 2,774 nesting attempts by 31 species of grassland birds, 1998-2001 (Table 4). Average apparent nest success for ducks and passerines has been about 30-60%. We crudely lumped data into 1, 2, and 3 yr post-fire categories (note: we expect to look the broader range of years since fire in our final analysis) . Using this approach, duck nest success was highest in 1st year post-fire plots (Table 5). Conversely, savannah sparrows had higher nest success in 2 and 3 yr post-fire plots, and bobolinks had higher success in 3rd year post-fire plots (Table 5).

Nest Site Vegetation: Mel Nenneman (University of Montana) completed field data collection in 2000 (1998-2000). Mel is examining several orders of nest site selection by savannah sparrow, clay-colored sparrow, and blue-winged teal within 1, 2, and 3 yr post-fire treatments. Using GBIRD protocol, Mel measured 353 nests, 909 associated paired-random plots (3-6 plots/nest within 30 m of the nest), and 209 random field-level plots (Table 6). Mel expects to complete his analysis and reporting by spring 2002.

In 2001, data collection continued to evaluate niche selection by a broad suite of grassland birds nesting in mixed-grass prairie. We hope to use 6-8 years of data from several study sites across northwestern North Dakota and eastern Montana to assess how grassland bird species partition breeding habitat. During 1998-2001, we have measure 642 nests of 17 species (Table 6).

Small Mammals: During 1998-2000, we captured 148 *Peromyscus*, 1,000 *Microtus*, 668 *Sorex*, 47 *Blarina*, 46 *Zapus*, 61 *Spermophilus*, 1 *Perognathus*, 3 *Onychomys*, and 6 *Mustela*. A very crude 3-year summary indicates higher relative abundance for *Peromyscus* in 1st year post-fire plots, compared to higher relative abundance for *Microtus, Sorex,* and *Blarina* in 2+ years post fire plots (Table 7).

Nest Cameras: We recorded 4 mouse, 10 thirteen-lined ground squirrel, 1 raccoon, 3 badger, 2 deer, 5 brown-headed cowbird, 1 hawk, and 2 garter snake predation events during 1998-99.

FUTURE STUDY PLANS

We will continue prescribed burning and data collection at J. Clark Salyer during 2002 and 2003. We expect to receive funding from the Joint Fire Science Council that will add replicate sites at Des Lacs and Lostwood NWRs in 2002 and 2003. We expect to complete data analysis and reporting by the end of 2004.

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Table 1. Prescribed burn units, burning sequence, and years since fire for J. Clark Slayer NWR study area.

		No. growing seasons since last burn (by study year)[a]					
Burn plot	**Acres**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
A	170	8	9[b]	1	2	3	4
C	105	1	2	3	4	1	2
D	240	5	6	1	2	3	1
F	190	5	1	2	3	4	1
G	120	12	1	2	1[c]	2	3
H	120	1	2	3	4	1	2
I	100	2	3	4	5	1	2

[a.] Because we are conducting late summer burns, 1 represents the first growing season following burns, 2 the second growing season since burn, etc.

[b.] Shaded blocks represent year of a treatment burn.

[c.] Block was burned in April 2001 and excluded from study in 2001.

Table 2. Apparent nest/fledging success (percent), predation rate, and parasitism rate for breeding grassland birds, J. Clark Salyer NWR, 2001.

Species	# of Nests	# Fates Known	Nests Predated	Nests Parasitized	Nests/broods Successful
Passerines					
BOBO	44	44	17 (39)	20 (45)	23 (52)
BRBL	2	2	1 (50)	1 (50)	1 (50)
CCSP	169	169	64 (38)	14 (8)	96 (57)
EAKI	2	2	2 (100)	0 (0)	0 (0)
LESP	5	5	2 (40)	0 (0)	3 (60)
RWBL	3	3	0 (0)	2 (67)	2 (67)
SAVS	137	137	62 (45)	18 (13)	66 (48)
SEWR	4	4	0 (0)	0 (0)	4 (100)
SOSP	3	3	0 (0)	2 (67)	3 (100)
WEME	3	3	2 (67)	1 (33)	1 (33)
Waterfowl					
AMWI	3	3	2 (67)		1 (33)
BWTE	119	119	47 (39)		63 (53)
GADW	116	116	59 (51)		46 (40)
LESC	2	2	1 (50)		1 (50)
MALL	92	92	62 (67)		19 (21)
NOPI	17	17	6 (35)		10 (59)
NSHO	43	43	18 (42)		22 (51)
Other Species					
NOHA	5	5	3 (60)		1 (20)
SEOW	1	1	1 (100)		0 (0)
Sharp-tailed grouse	3	3	2 (67)		1 (33)
UPSA	4	4	4 (100)		0 (0)
Total	777	777	355 (46)	57 (15)	363 (47)

Table 3. Number of nests by species within each burn block, J. Clark Salyer NWR, 2001.

	Burn Block						
	A	C	D	F	H	I	Total
Passerines							
BOBO	15	3	14	8	2	2	44
BRBL	1	0	0	1	0	0	2
CCSP	29	28	24	47	21	20	169
EAKI	0	1	0	1	0	0	2
LCSP	0	0	1	1	3	0	5
RWBL	2	1	0	0	0	0	3
SAVS	20	21	18	22	33	23	137
SEWR	0	0	1	0	1	2	4
SOSP	0	3	0	0	0	0	3
WEME	1	1	0	0	1	0	3
Total GNP[a]	37	25	33	32	39	25	191
Waterfowl							
AMWI	1	0	0	1	0	1	3
BWTE	21	17	18	19	13	31	119
GADW	17	12	26	20	23	18	116
LESC	0	0	0	0	0	2	2
MALL	14	13	21	6	17	21	92
NOPI	3	0	4	3	3	4	17
NSHO	3	0	4	3	3	4	17
Total Duck	59	42	73	52	59	81	366
Others							
NOHA	2	0	0	2	1	0	5
SEOW	0	0	1	0	0	0	1
Sharp-tailed grouse	0	1	1	0	0	1	3
UPSA	1	1	0	1	1	0	4
Total	133	105	137	141	125	136	777

[a]GNP = Ground Nesting Passerine species (BOBO, BRBL, LCSP, SAVS, CCLO, WEME, GRSP, BAIS).

Table 4. Apparent nest/fledging success (percent), predation rate, and parasitism rate for breeding grassland birds, J. Clark Slayer NWR 1998-2001.

Species	# of Nests	# Fates Known	Nests Predated	Nests Parasitized	Nests/broods Success
Passerines					
BAIS	4	4	3 (75)	0 (0)	1 (25)
BOBO	151	149	65 (44)	49 (33)	68 (46)
BRBL	13	13	7 (54)	4 (31)	5 (39)
CCLO	19	19	14 (74)	1 (5)	5 (26)
CCSP	577	577	202 (35)	80 (14)	323 (56)
COYE	1	1	0 (0)	0 (0)	1 (100)
EAKI	2	2	2 (100)	0 (0)	0 (0)
GRSP	7	7	2 (29)	1 (14)	4 (57)
LCSP	31	31	12 (39)	8 (26)	17 (55)
RWBL	43	43	24 (56)	6 (14)	15 (35)
SAVS	498	496	222 (45)	83 (17)	235 (47)
SEWR	10	10	1 (10)	0 (0)	9 (90)
SOSP	7	7	1 (14)	4 (57)	6 (86)
WEME	16	16	6 (38)	1 (6)	9 (56)
UNSP[a]	14	14	12 (86)	3 (21)	1 (7)
Waterfowl					
AGWT	2	2	1 (50)		1 (50)
AMWI	9	9	3 (33)		6 (67)
BWTE	459	458	191 (42)		223 (49)
GADW	362	361	171 (47)		159 (44)
LESC	4	4	3 (75)		1 (25)
MALL	271	270	124 (46)		109 (40)
NOPI	67	66	20 (30)		39 (59)
NSHO	143	141	46 (33)		78 (55)
REDH	1	1	1 (100)		0 (0)
Others					
AMBI	2	2	2 (100)		0 (0)
KILL	1	0			
NOHA	18	18	11 (61)		5 (28)
SEOW	9	9	4 (44)		4 (44)
SORA	1	1	0 (0)		1 (100)
S-tailed grouse	13	13	3 (23)		9 (69)
UPSA	18	18	10 (56)		6 (33)
WIPH	1	0			
Total	2774	2762	1163 (50)	240 (17)	1340 (49)

[a]. Unidentified sparrow nest

Table 5. Apparent nest success (percent) for 3 common passerine and duck species by burn interval 1998-2001. Total nests by species within each burn interval do not reflect preference or avoidance of the given burn interval (i.e., these totals do not reflect the number of plots used to calculate fate nor the number of acres searched).

1st Year Post-fire

Species	# of Nests	Fates Known	Nests Predated	Nests Parasitized	Nest/brood Successful
BOBO	42	41	18 (44)	8 (20)	18 (44)
CCSP	50	50	13 (26)	11 (22)	31 (62)
SAVS	42	42	26 (62)	10 (24)	13 (31)
BWTE	84	83	26 (31)		45 (54)
GADW	65	65	22 (34)		34 (52)
MALL	25	25	6 (24)		14 (56)

2nd Year Post- fire

Species	# of Nests	Fates Known	Nests Predated	Nests Parasitized	Nerst/broods Successful
BOBO	71	70	36 (51)	28 (40)	28 (40)
CCSP	147	147	50 (34)	22 (15)	82 (56)
SAVS	139	138	55 (40)	18 (13)	68 (49)
BWTE	138	138	60 (44)		69 (50)
GADW	122	121	58 (48)		54 (45)
MALL	100	100	50 (50)		39 (39)

3+ Years Post-fire

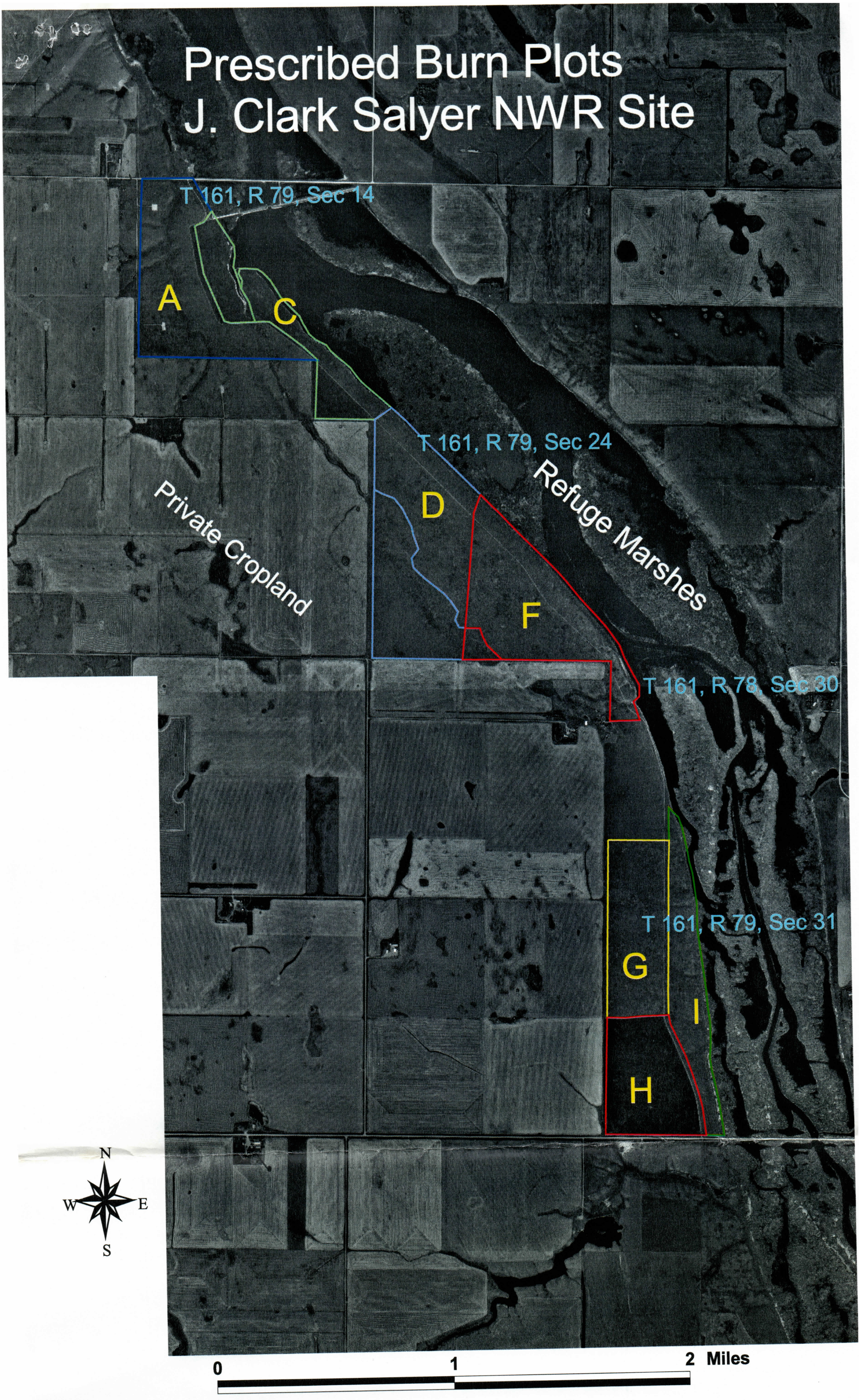
Species	# of Nests	Fates Known	Nests Predated	Nests Parasitized	Nests/broods Successful
BOBO	38	38	11 (29)	13 (34)	22 (58)
CCSP	380	371	139 (38)	47 (13)	210 (57)
SAVS	317	316	143 (45)	55 (17)	154 (49)
BWTE	237	237	105 (44)		109 (46)
GADW	175	175	91 (52)		71 (41)
MALL	146	145	68 (47)		56 (39)

Table 6. Grassland bird nests where vegetation was measured using modified GBIRD protocol 1998-2001. Paired Random Plots are 3-6 plots measured within 30 meters of a focal nest for SAVS, CCSP, and BWTE. South-end Refuge nests were measured in conjunction with another ongoing study.

Species	1st year post-fire	2nd year post-fire	3rd year post-fire	South-end refuge	Total nest plots	Paired random plots
SAVS	31	44	72	--	147	474
CCSP	28	41	57	4	130	267
BWTE	16	25	35	--	76	168
BOBO	19	41	13	--	73	--
GADW	8	24	28	--	60	--
MALL	1	14	9	--	24	--
NOPI	--	7	10	--	17	--
NOSH	--	4	9	--	13	--
VESP	--	--	--	19	19	--
CCLO	12	1	5	--	18	--
LESP	2	12	7	--	21	--
WEME	1	4	9	--	14	--
UPSA	--	3	6	--	9	--
BAIS	--	1	3	--	4	--
GRSP	--	1	3	2	6	--
SPPI	--	--	--	6	6	--
NOHA	--	2	3	--	5	--
Total	118	222	266	31	642	909

Table 7. Average total captures for 10 consecutive trapping nights each in June and July (20 total trapping nights) 1998-2000 by 1 yr- and 2+ yr post-fire treatments. Results are combined totals for both snap traps and pitfall traps averaged by burn plot.

Year	Treatment	*Peromyscus*	*Microtus*	*Sorex*	*Blarina*	*Zapus*	*Spermophilus*
1998	1yr post-fire	18.5	4.0	23.0	0.5	1.0	3.5
	2+yr post-fire	3.0	6.7	37.0	0.7	0.7	2.2
1999	1yr post-fire	13.3	50.0	23.3	2.3	4.7	2.3
	2+yr post-fire	2.2	115.0	32.4	6.8	3.0	4.0
2000	1yr post-fire	12.7	19.7	18.3	0	0.7	1.0
	2+yr post-fire	0.8	33.6	22.6	0.2	1.8	2.2



Prescribed Burn Plots
J. Clark Salyer NWR Site
T 161, R 79, Sec 14
A
C
T 161, R 79, Sec 24
D
F
Refuge Marshes
Private Cropland
T 161, R 78, Sec 30
T 161, R 79, Sec 31
G
I
H
N
W
E
S
0
1
2 Miles